In re Application of: Gabriel SIRAT et al.
Serial No.: 10/542,865
Filed: January 10, 2006
Final Office Action Mailing Date: June 9, 2008

Examiner: Bryan J. GIGLIO
Group Art Unit: 2877
Attorney Docket: 30238

REMARKS

Reconsideration of the above-identified application in view of the amendments above and the remarks following is respectfully requested.

Claims 428-430, 432-438, 440, 442-460, 462-472 and 475-479 are in this Application. Claims 1-427, 431, 441, 461, 473 and 474 have been previously cancelled. Claim 439 has been cancelled herewith. Claims 428-430, 432-437, 439, 440, 442-445, 447-450, 452-460, 462-469, 472, 476 and 478 have been rejected. Claims 438, 446 and 451 have been objected to. Claims 470, 471, 475, 477, 479 have been allowed. Claims 428, 432, 435, 440, 442, 452, 459, 470, 475, 476 and 477 have been amended.

The Application now comprises, after amendments, claims 428-430, 432-438, 440, 442-460, 462-472 and 475-479, of which claims 428, 470, 472, 476, 477 and 479 are in independent form.

Interview Summary

Applicants thank the Examiner for the courteous telephone interview granted on October 23, 2008. At this interview, Applicants' representative explained the difference between the present invention and the cited prior art. In particular, Applicants\ representative explained that Nagai does not teach, and even teaches away from generation of angle-dependent polarization phase-shift for the purpose of determining wavelengths.

Premature Finality

The Examiner has made the present Office Action as Final. It is the undersigned's opinion that the final rejection is premature.

The Examiner has taken the position that "birefringent crystal" further limits the claims and that it was introduced to render Funk et al. no longer anticipatory. The Examiner support this position by referring to the previous communication (May 25, 2008) which points out that the reference does not teach birefringent crystal, and holds that any new rejection is considered necessitated by amendment.

This line of reasoning is incorrect and compels the Applicants to conclude that the PTO finality is premature.

It is submitted that nowhere in the previous communication does the Applicants argue that the birefringent crystal further limits the claims. The term "birefringent crystal" has been introduced as replacement to the term "geometrical crystal filter" recited in claim 441 which was cancelled in the previous communication. However, as will be explained below a geometrical crystal filter and a birefringent crystal are equivalent terms.

Pages 25-26 of the specification as filed define a geometrical crystal filter as an anisotropic optical crystal in which an incident light ray is split into an ordinary ray and the extraordinary ray, each propagating within the crystal at its own velocity and with a polarization defined by the crystal symmetry. It is submitted that this definition of a geometrical crystal filter coincides with the definition of a birefringent crystal, since any birefringent crystal splits a light ray into an ordinary ray and the extraordinary ray. In this respect, the examiner is kindly requested to note that the Nature journal (http://www.nature.com/nrg/journal/v3/n10/glossary/nrg907_glossary.html) defines birefringence as "the splitting of an incident wave into two waves of different velocities and orthogonal polarizations."

It is therefore submitted that the term "birefringent crystal" is equivalent to the term "geometrical crystal filter". Thus, the substitution of "birefringent crystal" for "birefringent crystal" is not narrowing in scope.

The undersigned respectfully requests withdrawal of the finality of the rejection, because the Examiner introduced at least one new ground of rejection that is not necessitated by Applicants' amendment (MPEP §706.07(a)).

Applicants respectfully request the opportunity to present argument and/or amendment to overcome the rejections over the newly cited reference.

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35 U.S.C. §112 Rejection

Claim 432 stands rejected under 35 U.S.C. §112, second paragraph, as being dependent from a cancelled claim. Claim 432 has now been amended to depend from claim 430, thereby overcoming the 112 rejection with respect thereto.

35 U.S.C. §102 Rejections

Claims 428-430, 433-437, 439-440, 442-445, 447-450, 452, 454-457, 460, 462-465, 468, 472, 476 and 478 stand rejected under 35 U.S.C. §102(b) as being anticipated by Nagai (US Patent No. 5,570,180).

The Examiner identifies in Nagai all the elements of independent claims 428 and 472, including the light deflector, the encoder and the decoder. Specifically, the Examiner identifies Nagai's diffraction device as the light deflector, Nagai's optical shutter array as the encoder, and Nagai's signal processor as the decoder. The Examiner also identifies in Nagai all the steps of method claim 476 including the deflection, encoding and decoding of the light.

The rejections are respectfully traversed. Claims 428, 432, 435, 440, 442, 452, 459, 470, 475, 476 and 477 have been amended.

The following relates to the independent claims. The dependent claims are patentable at least by virtue of their dependency on their parent claims.

The claims before the Examiner are directed to apparatus and method for analyzing light by determining its wavelength or wavelengths. The wavelength(s) are determined in the following manner. The light is deflected according to its wavelength(s) to provide one or more wavelength-dependent angles, respectively corresponding to the wavelength(s) of the light. A birefringent crystal generates in the deflected light one or more angle-dependent polarization phase-shifts, respectively corresponding to the wavelength-dependent angles. Since the angle of deflection is a function of the wavelength, and since the polarization phase-shift is a function of the angle, the phase-shift is used for determining the wavelength of the light.

Nagai teaches a spectrometer which is based on an array of optical shutters, whereby each optical shutter is associated with a wavelength, and the intensity of

light at a given wavelength is determined by measuring the intensity of light passing through the optical shutter associated with this wavelength. The optical shutters are arranged in correspondence with wavelength bands as diffracted by a diffraction device for transmitting or blocking an incident ray of a given wavelength. The optical shutters operate according to electrooptical effect, whereby the transmittance of a particular shutter is controlled by voltage which corresponds to the wavelength band associated with the particular shutter. The voltage is applied to the shutters at a specified timing. A signal processor receives the ray which has passed through each optical shutter and outputs an electrical signal according to the intensity of the received ray. Since the rays pass shutters at specified timing, the shutter through which the light has passed can be identified. The intensity is associated with wavelength via time-synchronization between an intensity calculator and a voltage source.

Contrary to the instant claims, Nagai does not base his calculation of intensity on deflection angles or angles of incidence. It is submitted that Nagai does not determine a wavelength at all. Rather, Nagai measures the intensity for a given wavelength.

In order to properly understand how the Nagai's disclosure differs from the claims, it is important to understand how the device shown in Nagai operates and what problems Nagai had to solve. Nagai's FIG. 1 is typical, and is reproduced below for the Examiner's convince (reference signs **201-206** added by applicant).

Shown in Nagai's FIG. 1 is the diffraction device **4**, the array **60** of optical shutters, and an optical system **5** which is positioned between device **4** and array **60**. For each wavelength, optical system **5** concentrates (*i.e.*, focuses) the diffracted rays to a particular optical shutter (see column 5 lines 19-21). The optical system operates as a converging lens, and is referred to hereinafter as a lens, for clarity of presentation. Each shutter allows the light to pass therethrough at a different time (Column 3 lines 27-29). Once the light rays exit the shutter they enter (by means of optics **11**) a photoelectric detector **12** which outputs an electrical signal to the signal

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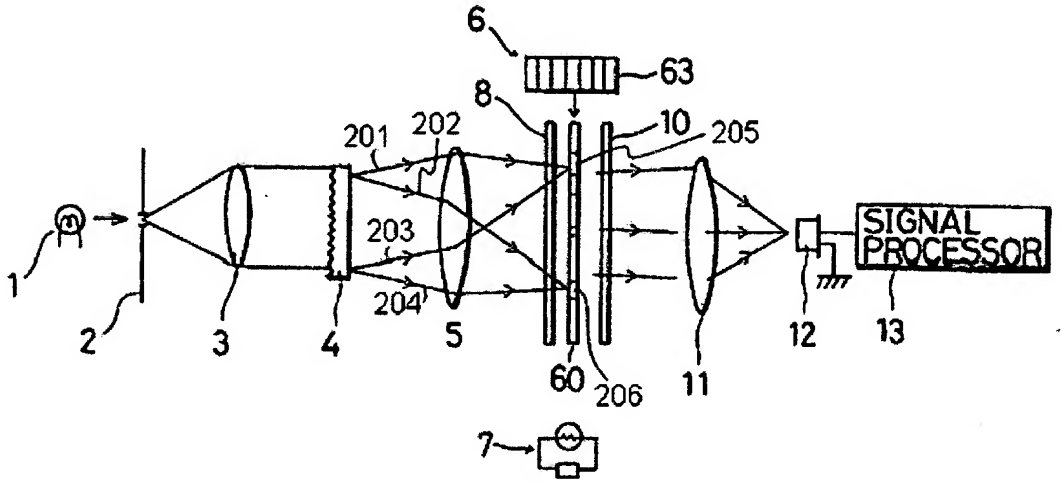
processor. Based on the timing at which the rays arrive at the detector, the shutter through which the light has passed can be identified.



Nagai shows four light rays exiting the diffraction device. These light rays have been marked by the Applicant by reference signs **201-204**. It is appreciated that these rays are representative examples of many more rays which are not shown.

Rays **201** and **203** exit the diffraction device parallel to each other and, according to the diffraction theory, are of the same wavelength. These rays are converged by the lens **5** to a single shutter **205** on array **60**. However, these rays impinge on shutter **205** at different angles. It is noted that there are many other (not-shown) light rays which exit the diffraction device parallel to rays **201** and **205**, but are redirected by the lens to impinge on shutter **205** at a plurality of different angles.

Similarly, rays **202** and **204** which exit diffraction device parallel to each other (hence are of the same wavelength), are converged by the lens to a single shutter **206** and impinge on shutter **206** (together with many other not-shown light rays) at different angles.

According to Nagai, the association of signal to wavelength is based on the location of the light ray on array **60**. The angle at which the light arrives at array **60** has no effect to the identification of the shutter since the same shutter is provided with

light rays from a plurality of angles (*e.g.*, shutter **205** receiving non-parallel rays **201** and **203**, and shutter **206** receiving non-parallel rays **202** and **204**). In other words, by the time the light arrives at array **60**, all information regarding the diffraction angles is lost.

In sharp contrast, the instant claims require a relation between the wavelength and the angle. Specifically, the wavelength corresponds to an angle-dependent polarization phase-shift, namely to a phase-shift which is a function of the angle of incidence on the encoder.

It is submitted that Nagai is silent with respect to any relation between the wavelength and the angle, and certainly with respect to correspondence between wavelength and an angle-dependent polarization phase-shift. Moreover, since Nagai destroys all information regarding the diffraction angles, Nagai effectively teaches away from the claims.

On the passage bridging pages 5 and 6 of the Final Office Action, the Examiner states that Nagai teaches a birefringent crystal which is capable of encoding said deflected light beam so as to provide an encoded light beam characterized by at least one angle-dependent polarization state. In regard to the birefringent crystal, the Examiner refers to Column 5 lines 48-50 ("PLZT"), and Column 6 lines 7-8 ("birefringence occurs"). In regard to the angle-dependent polarization state the Examiner refers to Column 6 (presumably the entire column), and Column 10 lines 9-20.

Applicants respectfully disagree with the Examiner interpretation of Nagai. It is correct that Nagai explains that birefringence occurs at the PLZT. However, nowhere in Nagai's disclosure is there even a hint that the PLZT provides an angle-dependent polarization state. Column 6, to which the Examiner has referred, describes the relation between the intensity of the light and the phase difference which arises between ordinary and extraordinary rays. This relation, however, is not affected by angles of incidence at all. Column 10 lines 9-20, to which the Examiner has also referred, describe the use of a polarizer which (i) is not a birefringent crystal, and (i) does not provide an angle-dependent polarization state. It is noted that the

operation of the polarizer simply cannot be affected by the angle of incidence due to the enormous number of different angles which arrive to the polarizer.

Thus, angle-dependent polarization state is neither explicit nor implicit to Nagai.

On page 7 of the Final Office Action (in regard to claim 439) the Examiner states that Nagai teaches encoder which is operable to generate at least one angle-dependent polarization phase-shift, thereby to provide said polarization state or said polarization states. In this respect the Examiner refers to Column 6 lines 5-55.

Applicants respectfully disagree with this interpretation. The mere reference to the term "phase difference" in Nagai does not mean that an angle-dependent polarization phase-shift is generated. This observation will now be explained.

Firstly, since in Nagai's device there is no unique relation between the angle of incidence and the wavelength, there can be no dependence between the phase-shift and the angles. This observation is supported by Nagai's own description. For example, column 6 lines 17-22 describe that the phase difference Γ is related to the wavelength. On the other hand, FIG. 1 shows at least two angles of incidence which correspond to the same wavelength. Thus, the phase difference is not affected by the angles.

Secondly, Nagai uses the applied voltage to control the phase difference (Column 6 lines 25-30). Thus, Nagai's phase difference is voltage-dependent and not angle-dependent. Nagai tailors the phase difference so as to transmit or block the light. Specifically, Nagai teaches that the voltage should be selected such that the phase difference is half the wavelength, and adopts the term "half-wavelength voltage" (Column 6 lines 49-55). Thus, Nagai's phase difference essentially equals half the wavelength at all times, and is therefore predetermined. It is noted that the term "half-wavelength voltage" appears 17 times in Nagai's disclosure.

Thirdly, the principle of operation of Nagai involves application of voltage at a specified timing, whereby different shutters (associated with different wavelengths) are applied with the half-wavelength voltage at different times. Thus, from the

standpoint of array **60** as a whole, the phase difference generated by array **60** is a function of the time, rather than the angle.

It is therefore submitted that Nagai does not anticipate or render obvious the independent claims because Nagai does not teach or imply (i) use of birefringent crystal for generating an angle-dependent polarization phase-shift which corresponds to a wavelength-dependent angle; (ii) determination of wavelength; and (iii) determination of wavelength based on the angle-dependent polarization phase-shift.

35 U.S.C. §103 Rejections

Claims 428-430, 433-437, 439, 440, 442-445, 447-450, 452-460, 462-465 and 467-469 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Funk, *et al.* (US Patent No. 6,031,609), in view of Nagai.

The Examiner identifies in Funk *et al.* all the elements of claim 428, including the light deflector, the encoder and the decoder. Specifically, the Examiner identifies Funk's prism 16 as the light deflector of claim 428, Funk's LCD mask as the encoder of claim 428, and Funk's elements 42, 46 and 48 as the decoder of claim 428.

The Examiner acknowledges that Funk *et al.* is silent to the encoder comprising at least one birefringent crystal, per se, but holds that Nagai's birefringent crystal array is functionally equivalent to the liquid crystal array as taught by Funk *et al.*, and would have been an obvious alternative to the LC device.

The Examiner's rejection is respectfully traversed. Nagai does not provide what Funk *et al.* lacks.

The following relates to the independent claim. The dependent claims are patentable at least by virtue of their dependency on their parent claims.

Funk *et al.* disclose a Fourier transform spectrometer for obtaining a spectrum of a sample. Light from a polychromatic light source is dispersed into spectral components. A polarizer provides a polarization angle to the dispersed light, and a multiple-element polarizing device encodes each spectral component of the light with a different time-varying dependence of polarization rotation. A second polarizer generates a time-varying intensity for each spectral component. The intensity

modulated and dispersed light is collimated into a single light beam which is thereafter split into a sample light beam and a reference light beam. The sample light beam passes through the sample. A Fourier transform is performed to both the beams to obtain a spectrum of the sample.

It is submitted that since Funk's spectrometer includes a light source, the wavelengths of the light exiting the source are already known. Thus, Funk *et al.* provide a technique for analyzing a sample rather than light. Since Funk *et al.* know the wavelengths of the light in advance their Fourier transform spectrometer does not determine the wavelengths of the light. More specifically, each element of Funk's LCD mask is designated to a specific wavelength and is applied with a specific voltage for rotating the polarization of the light. However, as will be appreciated by the Examiner, this specific voltage can only be applied if the specific wavelength of the respective LCD element is known. To this end see Column 2 Lines 40-46 and Column 4 lines 35-40 of Funk *et al.*

The Examiner states (page 15 of the Final Office action, in regard to claim 439) that Funk *et al.* teach the generation of angle-dependent polarization phase-shifts. The Examiner refers to Column 4 lines 61-67 stating that LCD phase shifts light between elements 22 and 26.

Applicants traverse this contention and states that Funk *et al.* is completely silent with respect to phase shift, and certainly with respect to angle-dependent polarization phase-shift. It is noted that an LCD is not capable of generating a phase shift that depends on the angle of incidence. Moreover, Funk *et al.* destroy all information regarding the differences in the angles of incidence on the LCD, as will now be explained with reference to Funk's FIG. 1, which is reproduced below for the Examiner's convenience.

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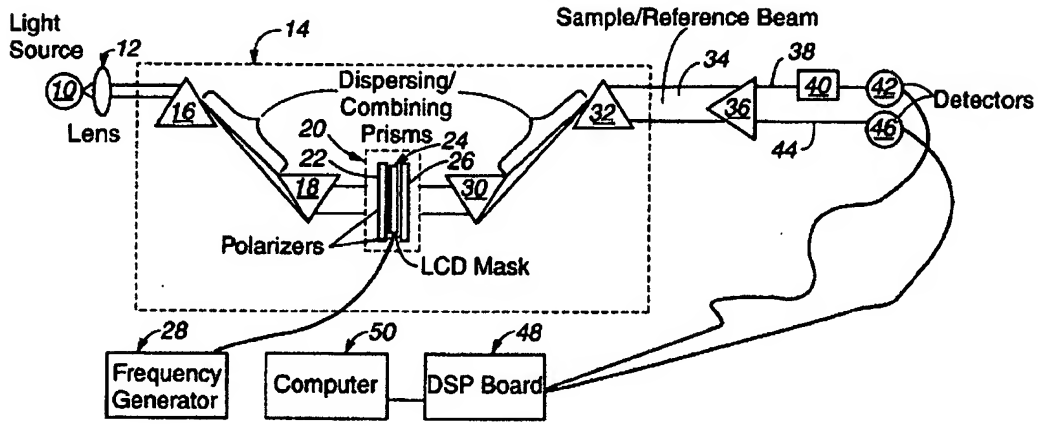

As shown, Funk's device **14** includes a pair of prisms **16** (dispersing prism) and **18** (paralleling prism), see also Column 4 lines 25 and 26. The non-parallel light rays exiting dispersing prism **16** are being parallelized by paralleling prism **18**. As a result, all light rays arrive at the LCD mask **24** at the same angle.

Thus, both Funk *et al.* and Nagai deliberately destroy the angular information but in opposite ways: while Nagai provides a plurality of angles per wavelength, Funk *et al.* provides the same angle for all wavelengths.

It is therefore submitted that claim 428 are is not rendered obvious by Funk *et al.* or Nagai because none of Funk *et al.* and Nagai discloses or imply (i) use of birefringent crystal for generating an angle-dependent polarization phase-shift which correspond to a wavelength-dependent angle; (ii) determination of wavelength; and (iii) determination of wavelength based on the angle-dependent polarization phase-shift.

Allowable Subject Matter

The Examiner has pointed out that claims 470, 471, 475, 477 and 479 are allowed.

The Examiner further pointed out that claims 438, 446 and 451 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

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Claim Amendments

The amendment to the claims is not substantial and does no more than to make explicit what was already implicit in the claims.

Independent claims 428, 470, 476 and 477 have been amended and now include some of limitations found in claim 472.

Claim 475 has been redrafted in dependent form and is now dependent from claim 428.

Claims 432, 440 and 442 have been amended so as not to depend from a cancelled claim.

Claim 435 has been amended to better clarify the relation between the beam splitter and the light deflector, in accordance with FIG. 1a of the specification as filed.

Claim 452 has been amended to recite "a geometrical crystal filter" instead of "an additional geometrical crystal filter". Also, the dependency of the claim was amended so as not to depend from a cancelled claim.

Claim 459 has been amended to recite "an anamorphic prism" instead of "a second anamorphic prism".

US Patent No. 4,448,529 to Krause has been carefully reviewed but is deemed not to anticipate nor render obvious Applicants' claims, at least because Krause does not teach or imply use of birefringent crystal for generating an angle-dependent polarization phase-shift which corresponds to a wavelength-dependent angle, and determination of wavelength based on the angle-dependent polarization phase-shift.

In view of the above amendments and remarks it is respectfully submitted that the claims are now in condition for allowance. A prompt notice of allowance is respectfully and earnestly solicited.

Respectfully submitted,

Date: November 10, 2008

Martin D. Moynihan
Registration No. 40,338

Enclosures:

- Amendment Transmittal; and
- Petition for Extension of Time (2 Months)